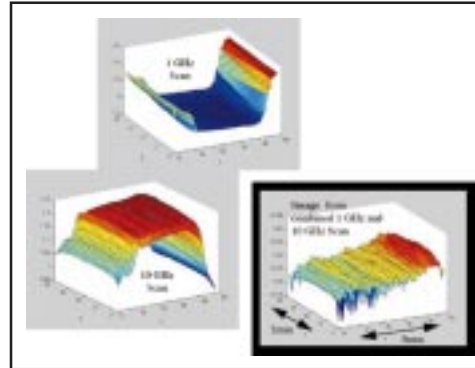




# EVANESCENT MICROWAVE PROBE MAY REVOLUTIONIZE MATERIAL COATINGS EXAMINATION PROCESS

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## Payoff

The evanescent microwave probe, with its ultra-fine resolution scans, provides researchers with an opportunity to assess potential composition changes in materials coatings before they occur, without harming the structure of the material. This capability will allow Air Force engineers to identify material problems in spacecraft components before the coating is applied to the component and could prove to be extremely useful and cost effective in analyzing aircraft coatings. The evanescent microwave probe also has a large, diversified spectrum of commercial applications and could revolutionize industries where the sensor can be used to perform reliability checks on computer components and other important products.

## Accomplishment

An innovative research effort supported by the Materials and Manufacturing Directorate (ML) led to the successful development of a sensor device that could revolutionize the way coating properties are examined on space vehicles, computer components and other military and commercial products. Developed for the Air Force under the Small Business Innovation Research (SBIR) program, the new probe uses microwaves to determine the spatial distributions of electrical resistivity and other electromagnetic properties of conducting, semi-conducting and insulating materials without damaging the material structure.

## Background

The increased emphasis in recent years on space exploration has prompted Air Force materials engineers to be more focused on examining property changes in thin-film coatings on space vehicle components. Until recently, however, these changes could be studied only after the coatings were applied and had transformed, limiting the understanding of the process, as well as, preventive measures to strengthen and preserve the integrity of the coatings. Scientists at ML entered into a SBIR research and development effort with the Manufacturing Instrumentation Consulting Company, in Cleveland, OH, to improve the examination process using evanescent microwave technology. This technology was developed by Dr. Massood Tabib-Azar, a professor at Case Western Reserve University (CWRU). Based on initial research findings published in 1993, the SBIR program sought to provide Air Force material researchers with an opportunity to examine composition changes while they occur, in real time. The evanescent microwave probe has only been used in government tests, yet has demonstrated a strong potential for applications ranging from checking the reliability of computer components and handheld wireless circuitry to imaging tooth decay. The probe is about one-fourth the thickness of a strand of human hair and is capable of generating high-resolution images as it draws nearer to a sample, using suitable microwave frequencies. Dr. Tabib-Azar's research team is currently testing two evanescent microwave probes at a research laboratory near CWRU. The larger of the two probes is used to scan highly detailed material samples such as surface areas of computer circuit boards. The smaller one provides large area scans for low-resistivity samples. Scanning of highly detailed coating surfaces requires the use of a computer to track values and produce the scans. The system then maps the variation in amplitude of the reflected electronic wave as the microwave probe is moved across the sample at a known distance. The resultant scans are then analyzed to determine the properties of the sample material, while providing important information to the research team on the coating's integrity and durability, before the coating is applied to working components.